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SUBJECT: Final Report AFOSR Grant Nr AF-AFOSR-1209-67

This Grant, which ran from 1 October 1966 to 30 September 1967, was intended to serve as "seed money" in initiating a program of research into the Properties of Electrically Excitable Membranes.

As seed money it was used primarily to purchase basic equipment with which to set up a laboratory. This equipment included, for example, a Wild dissecting microscope (model M5), a Leitz research microscope (model Labolux D) and a Tektronix oscilloscope (model 561A). The laboratory is now fairly complete.

With regard to the research itself, the following progress can be listed:

1. A theoretical paper entitled "A Contribution to the Electromagnetic Theory of the Unmyelinated Axon" has been accepted for publication by Mathematical Biosciences. In this paper certain of the simplifying assumptions commonly made about the electromagnetic properties of unmyelinated axons are investigated by obtaining solutions to the scalar wave equation. It is shown that, as anticipated, the axoplasm is sensibly equipotential and that the membrane

current is linearly proportional to the second derivative of the action potential to within 1%; however, contrary to one's intuition, the external potential is not simply related to the membrane current.

2. A theoretical paper entitled "A Postulational Approach to the Problem of Ion Flux through Membranes" has been submitted to the Journal of Theoretical Biology. This work was undertaken to discover ways in which the experimental data relating to ion fluxes could be processed to yield maximum information about the underlying behavior of the excitable membrane. The chief result obtained was that, having made only a few seemingly quite general assumptions, the flux at any instant of a given ionic species could be predicted except for a permeability P and a function G(V) of membrane voltage where G(V) is of relatively restricted form. From this one can obtain the Goldman-Hodgkin-Katz formulation with relative ease. Further, one can readily explain the kinetics of the action of the tetraethylammonium ion on squid axon.

3. The electronic circuitry needed for voltage clamping medullated nerve was built. This involved the construction of a negative capacitance electrometer of unusually fast response

and of the design of a circuit to compensate for signal distortion by the distributed capacitance of the internodes.

4. On a more purely biological level, the technique of dissecting single fibres from frog sciatic nerve was mastered. To provide an alternative preparation, a culture of the electrically excitable alga Chara braunii was established.

5. The remaining bottleneck is the fabrication of equipment suitable for holding a given excitable cell during an experiment. Principally because of the small sizes involved, this has turned out to be unexpectedly difficult. The problems encountered have now mostly been resolved and it is anticipated the actual voltage clamping experiments will be actively under way by the end of November.

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